the Atom

Los Alamos Scientific Laboratory

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In this Issue

Regular Features

Editor

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Photography

Bill Jack Rodgers, Johnnie Martinez, and L-4 scientists.

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FRONT COVER

ISD-1 photographer Johnnie Martinez' cover photo captures the size and beauty of the 35-cm (14-inch) diameter reflector mirror used in the 8-beam CO_2 system of lasers being developed at LASL. The mirror frames (from left) Roy Johnston, Dick Johnston, and Randy Carlson, all of L-1. Mike Montgomery, L-1, is almost obscured by the brilliant reflection in the mirror, held by Joe Ladish, L-1.

BACK COVER

Bill Jack Rodgers of ISD-1 took the back cover photo of a mass of ice that appears to ignore gravity.

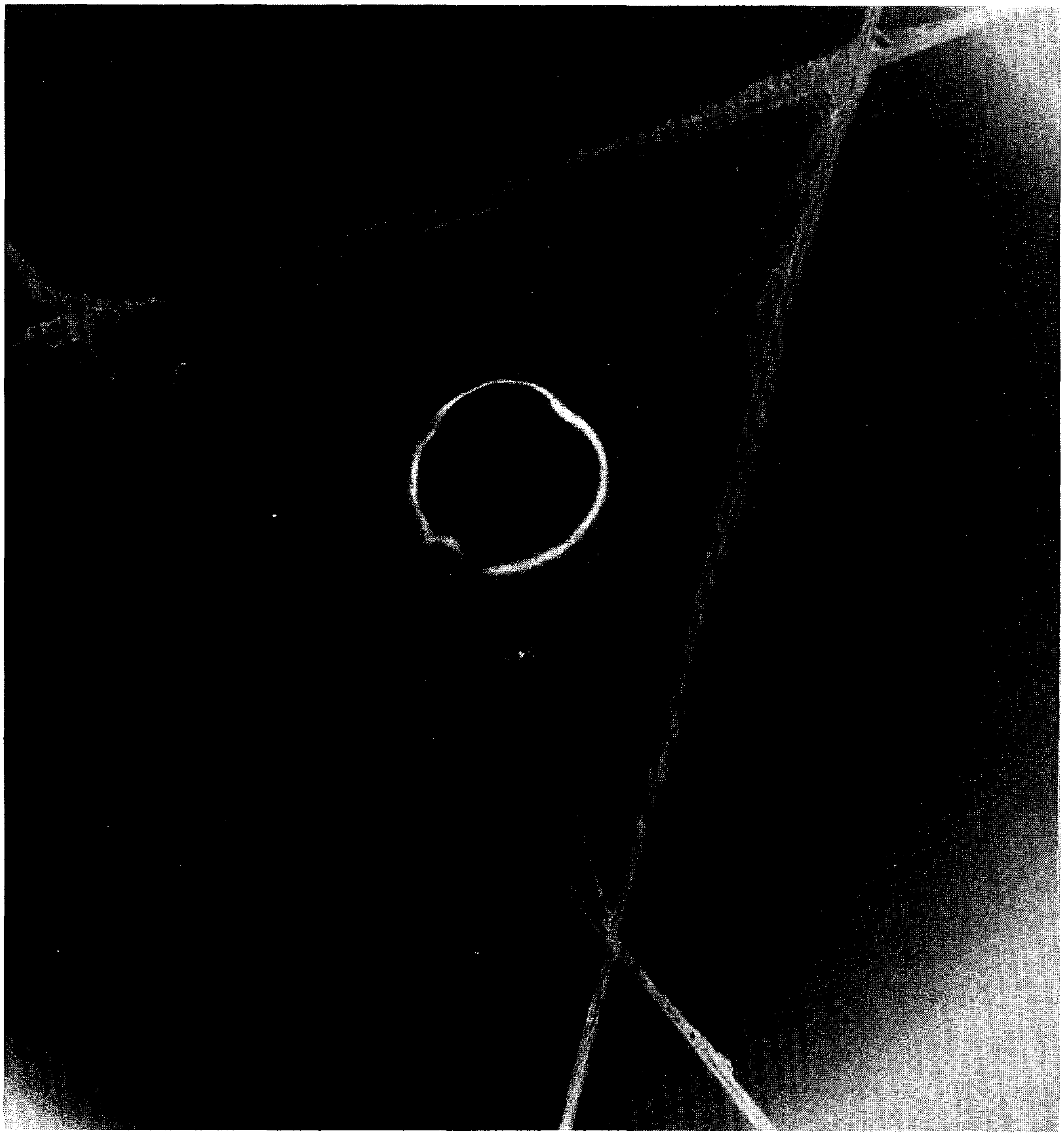
On The Subject Of Fusion Energy . . .

By BARB MULKIN

Competition is healthy and productive. America has thrived on this dictum, whether it pertained to Fords or Chevvies or television network ratings. It certainly has also applied, to the nth degree, to the race to achieve fusion energy. Which is why excitement is evident in LASL's Laser Research and Technology Division just now.

Late in January, L-Division researchers reported they had achieved *compression of a microscopic*, deuterium-tritium fuel pellet using LASL's two-beam carbon-dioxide (CO_2) laser system. A detectable flux of 14-MeV (million-electron-volt) neutrons characteristic of thermonuclear fusion reactions was produced.

It is the first time compression and neutron flux have ever been obtained with a CO_2 laser. In the words of Gene McCall, alternate division head of L-Division, "Our recent results in understanding the basic physics of target experiments and the success of the compression experiment present the possibility that the CO_2 laser may indeed be the laser of choice for future laser-



Before and after pictures of a deuterium-tritium-filled glass pellet are magnified about 250 times. The microscopic target sphere (center, picture above) is mounted between 2 sheets of extremely thin plastic foil (40 nanometers thick). The assembly is suspended in a triangle formed of glass wires (angel hair), before being heated slightly to bond the plastic foil to the microballoon. The picture at right was taken with an x-ray pinhole camera. It shows a similar ball and disk target successfully imploded with L-Division's two-beam carbon dioxide laser system. The bright dot at the center of the picture shows compression of the core. Hot plasma outlines the shell of the microballoon shown here at a slightly different angle but about the same size as the unimploded target pellet above.

fusion power reactors. The experiment is an important step toward understanding the processes involved in laser fusion."

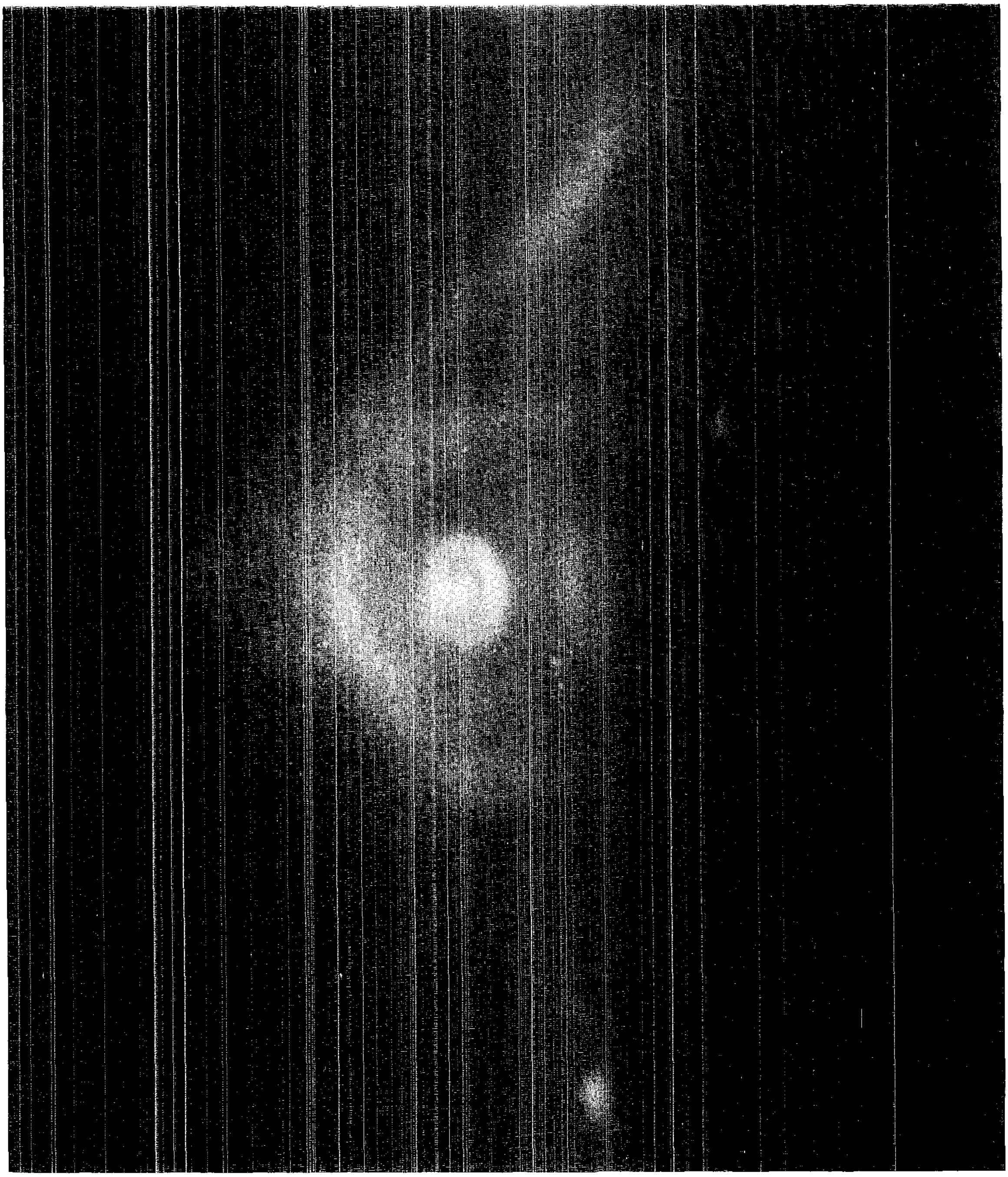
The two leading contenders in the field of laser fusion are the CO_2 and the neodymium-glass (Nd) laser. LASL's primary effort has been development of carbon-dioxide systems.

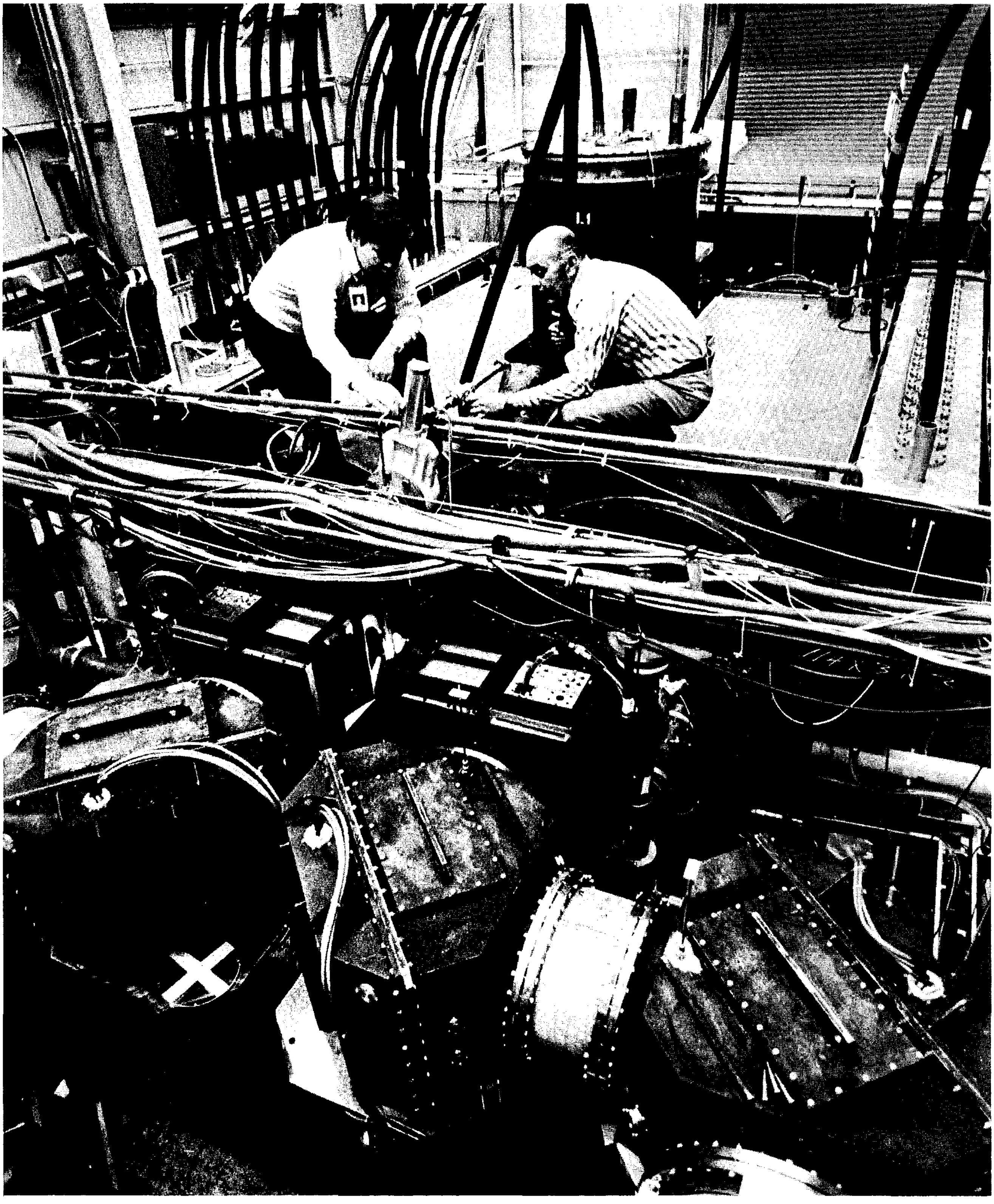
Basically, the ultimate laser, dubbed "Brand X" in the field, should have high efficiency (the efficiency with which electrical energy is converted to laser light); a high repetition rate (the capability of delivering short, intense bursts of power in rapid sequence); and "scalability" (the potential for practical development into a system able to deliver 1 megajoule or more of energy in each pulse).

Brand X remains just that. A yet-to-be-discovered lasing medium having the essential elements just described.

Both the CO_2 and the Nd-glass laser offer pluses and minuses in the context of what an ideal laser system for a fusion reactor should have.

The glass laser can use conventional optics and materials, but it lacks the capacity for high repetition and, so far, the necessary efficiency. By comparison, the carbon-





Jerry Parker, left, L-1 assistant group leader, and Sid Singer, L-1 group leader, confer from a vantage point on top of the amplifier module of the two-beam laser system.

dioxide laser has high repetition capability and demonstrated efficiency and scalability, but its wavelength, in the middle infrared segment of the spectrum at 10 micrometers, was judged an obstacle to be overcome if it was to qualify as a laser of choice for a fusion reactor.

Now, however, LASL scientists say wavelength is no longer a problem.

Sidney Singer, group leader of L-1 (CO_2 Laser Systems Development Group), sums it up: "Now that we have induced fusion reactions in pellets using a CO_2 system, our contention that the comparatively long wavelength of this laser does not present a problem has been confirmed."

"... we may lop 10 or even 20 years from the generally accepted time required for development of a laser-fusion reactor ..."

Controlled thermonuclear fusion is perhaps the most technically demanding of all the concepts being investigated as commercial sources of power.

The concept of fusion has been successfully demonstrated in the development of hydrogen weapons. But controlled fusion was considered more difficult than fission—the splitting of the atom to release large amounts of energy. It proved easier to split an atom and harness the resultant energy for power. Growing controversy over the safety of nuclear fission and its inevitable byproducts, and the recent energy crisis, intensified the interest in fusion, the confining of atoms (especially the heavy isotopes of hydrogen, deuterium, and tritium) releasing large amounts of energy in a process that should prove cleaner, and cheaper, than fission.

Laser-induced fusion is a relative newcomer to the field of controlled thermonuclear fusion research. No matter what laser is used, the object is to compress a target fuel pellet with sufficient energy to trigger thermonuclear reactions that release large amounts of energy.

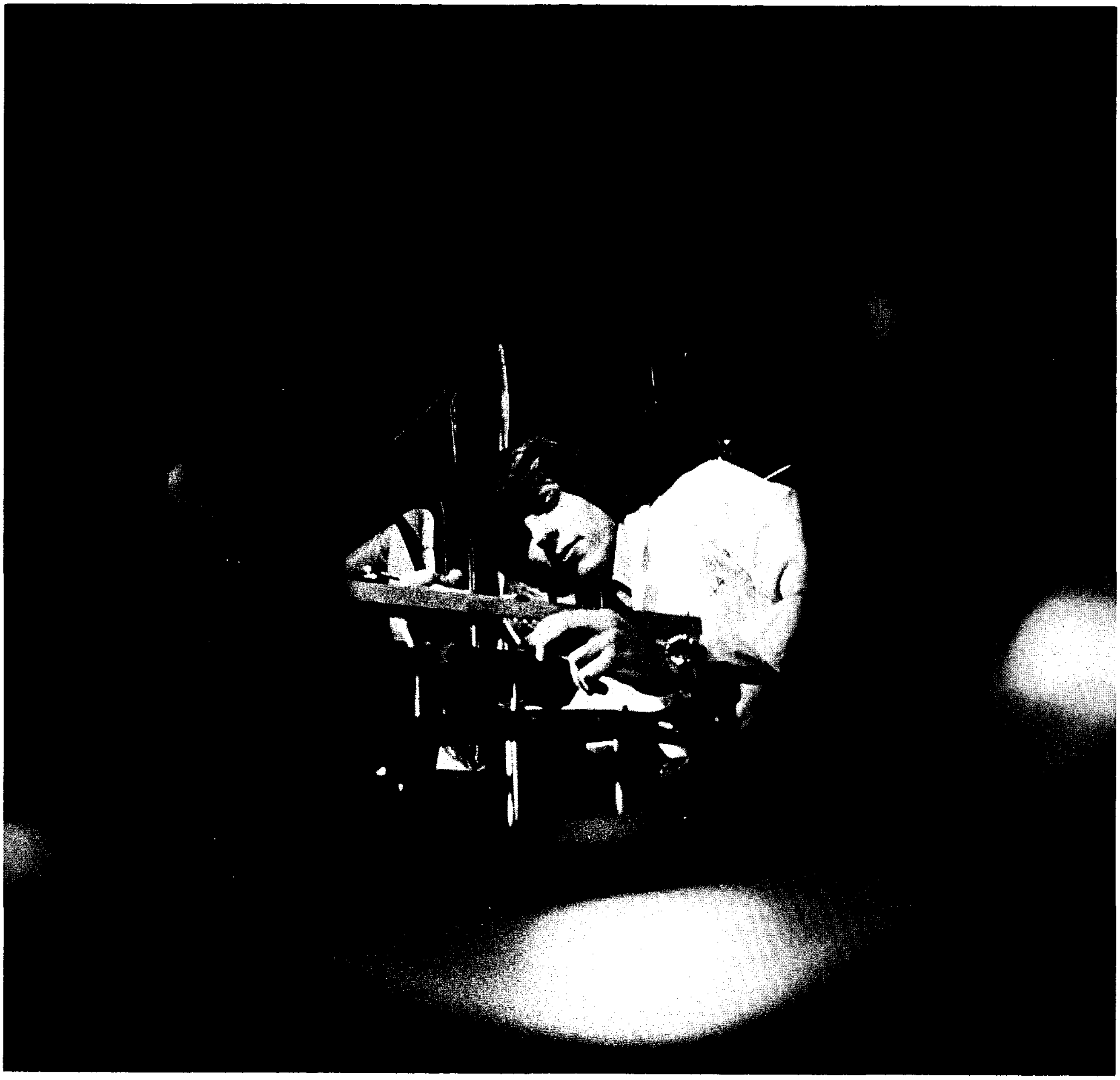
Such reactions are triggered by exciting deuterium and tritium atoms to the extent that the electrons will escape their orbits around the nucleus of the atom and, in so doing, leave behind charged nuclei (ions). Ions have a positive electrical charge, and if brought together will repel each other with great force. However, if sufficient energy and pressure are delivered to the hot gas (plasma) which a collection of ions forms, ions will attain such random velocities that pairs of them will overcome the nuclear repulsive forces and fuse, or combine, into a larger nucleus (helium) and a 14-MeV neutron. In doing so, mass is converted to the energy of motion of the neutron.

Detection of such a flux of neutrons in January marked a milestone in the LASL laser research program, which in 1970 expanded a small effort in existence since 1963, with construction of a single-beam carbon-dioxide laser.

Painstakingly, the inherent problems of laser development have been overcome through a series of integrated programs that by 1981 may result in completion of a machine able to demonstrate "scientific breakeven" in laser fusion. That is the point at which the amount of energy released by fusion reactions equals the amount of energy that was required to produce them. Until breakeven is demonstrated, fusion reactors will remain simply a concept.

Jerry Parker, assistant L-1 group leader and section head of the two-beam CO_2 laser system, describes the two-beam system as "being built, initially, to prove the feasibility of using a large amplifier (for the laser beam) and to investigate the physics of laser interaction with targets (fuel pellets)."

However, Parker says, within a year, development of the laser system itself, and results of target experiment theory, indicated a transition "toward target work."



Joe Svacek, L-4, adjusts components of target positioning apparatus in the target chamber of the two-beam CO_2 laser system. The picture was taken through a porthole in the target chamber.

The thrust of the two-beam program changed accordingly in favor of target experiments. The successful January experiment has delayed plans to switch to development aimed at increasing the energy of the laser system itself, according to Parker.

The two-beam laser target experiments, which began in October, 1976, culminated successfully in compression of a fuel pellet.

Compression is the key word in laser fusion. When powerful laser energy reaches a fuel pellet it quickly heats the electrons on the outer surface of the pellet, causing a plasma to form that rapidly expands outward (blows off). The recoil impulse from this rapid blow-off of the outer layer of the pellet compresses the pellet core, much as a rocket's exhaust thrusts a rocket forward, with a resultant release of energy.

The assumption that the long wavelength of the CO_2 laser posed a problem involved the location of the laser energy deposition in relationship to the pellet, according to Parker.

"Basically, you are heating electrons, and it was thought that long wavelength lasers would deposit too much of their energy far from the surface of the pellet, making very hot electrons and producing a situation precluding compression of the fuel," Parker explains.

Nd-glass lasers, with their shorter wavelength (1 micrometer), could deposit their energy closer to the target, where the plasma is denser, thus gaining maximum effect from heated electrons, according to theory.

"In fact," Parker now says, "the experimental results we obtained in January demonstrated that this picture was incorrect. A new theoretical model has been elucidated in which the laser light pressure forces the hot electrons close to the surface of the pellet to increase the 'coupling' of electron energy into the target."

The new ideas, developed as a result of the collaboration between members of L-4 and T-6, were summarized in November, 1976, by Damon Giovanelli, group leader of L-4 (Experiments and Diagnostics), in a paper delivered at a meeting in San Francisco of the Plasma Physics Division of the American Physical Society. The compression of a pellet confirmed many of these ideas.

For the "two-beam" people in L-Division, Murlin Nutter, Jim Carpenter, and Jim Hayden, who run the system with their aides, Alton Patrick, Dick Basinger, Dave Hebron, Dave Garcia, Larry Sprouse, and Victor Romero, the overturning of a negative, long-held theory will provide incentive, but there will be no time to rest on their laurels.

Parker says there are many areas in which "we have to learn whether the computer codes can predict what we are observing, as happened with the January experiment."

The nature of LASL's overall CO_2 laser program demands this, he explains.

The two-beam system and the target experiments were built, literally, on what was learned from the single-beam system, and the eight-beam system now under construction gains from the experience with the two-beam system. All of these developments, in turn, support the High Energy Gas Laser Facility.

The proposed High Energy Gas Laser Facility (HEGLF), a \$55-million machine with an annular configuration of 6 modules and a total of 72 beams, which is designed to demonstrate scientific breakeven, will lean heavily on the total experience of CO_2 laser research in the many groups in L-Division. Start of construction of HEGLF is scheduled this year, with completion expected in 1981.

Breakeven may be achieved sooner than hoped for. Sid Singer and Gene McCall regard the results obtained with CO_2 lasers as so significant that they contend that by eliminating the need to search for a "Brand X" laser, we may lop 10 or even 20 years from the generally accepted time required for development of a laser-fusion reactor (usually estimated to occur early in the next century), and we may realize a considerable dollar saving.

By disposing of the problem of wavelength, researchers may now be able to concentrate with more confidence on the area of major concern—development of the laser system and target designs which are needed for a fusion reactor.

(See companion story on LASL's two-beam and eight-beam laser systems, page 8.)

Until breakeven is demonstrated, fusion reactors will remain simply a concept.

More On LASL Achievements In Fusion By Lasers

Early in March, the biggest germanium polycrystal ever grown in the United States was delivered to the Los Alamos Scientific Laboratory. It will help solve one of the major problems confronting researchers developing the largest, high-energy, short-pulse carbon dioxide (CO_2) laser system in the world.

Lasers just naturally seem to generate superlatives in those who write about them. To the layman they are exotic by nature. To the scientist they are a very interesting technical challenge.

In principle, a laser appears to be a relatively simple thing. It operates when atoms or molecules in the lasing medium are excited by a jolt of energy from their normal rest or ground state to a higher energy level. When triggered by photons of the exact same energy, they will jump back to lower energy levels, giving off a stimulated emission of radiation in the form of light. This occurs in avalanche fashion and results in light amplification. The output is either a steady beam of light, if the lasing medium is steadily pumped, or short, powerful bursts of light, if intermittently pumped.

There the apparent simplicity ends, for the problems associated with development of lasers increase proportionately as bigger, more efficient systems are designed.

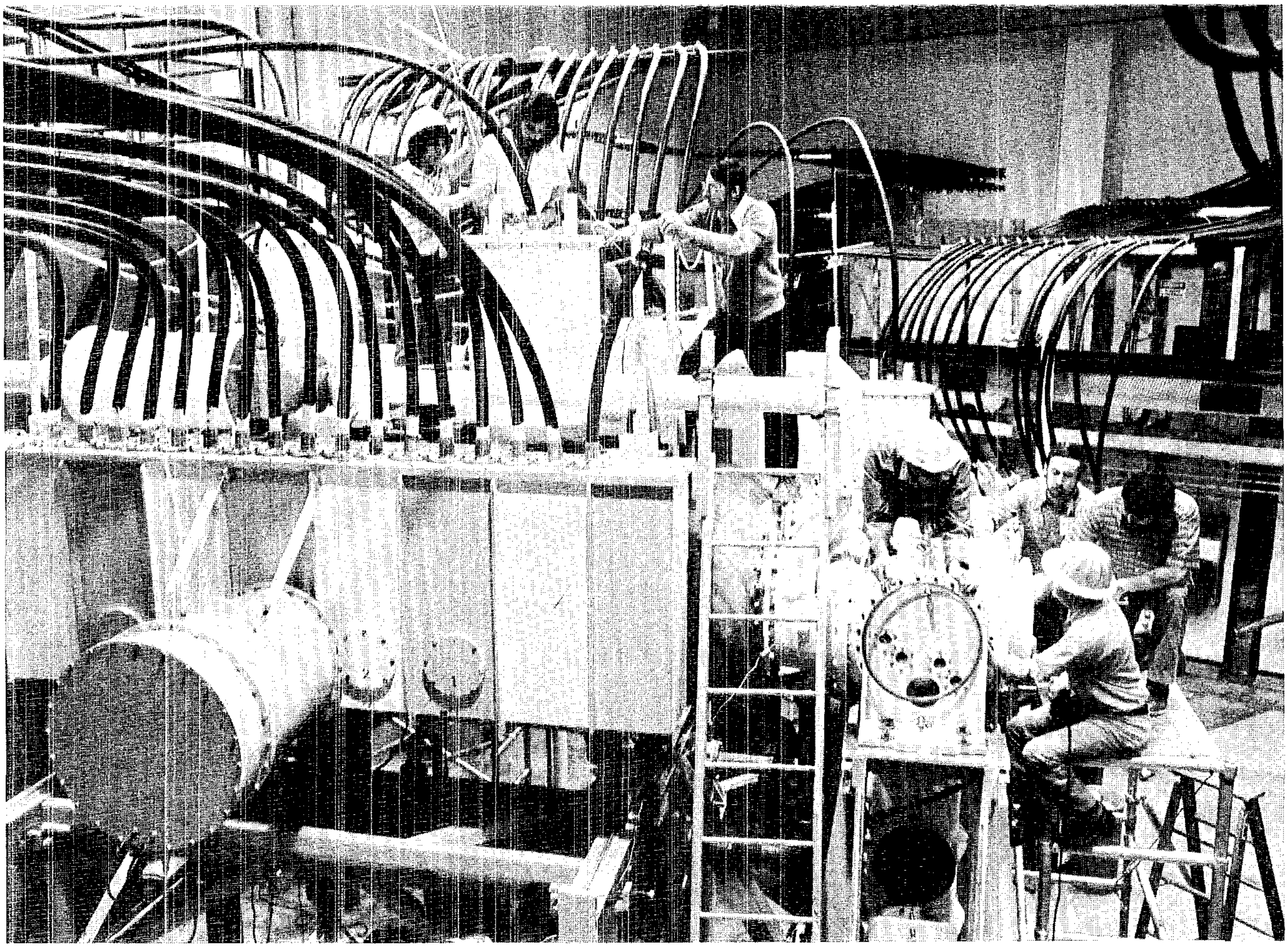
In the case of lasers for fusion, which require extreme amounts of power to heat the heavy isotopes of hydrogen to fusion temperatures, the problems are formidable. Solving them requires time, money, and the dedication of many people in related disciplines.

Solutions to a variety of such problems have already been found in the Laboratory's Laser Research and Technology Division. The huge germanium polycrystal is a prime example. Its sole purpose is to absorb reflected light near the business end of the eight-beam CO_2 laser system now under construction in L-Division. Without it, spontaneous lasing of the beam would occur in the system. This would either destroy the target prematurely by preheating, or severely damage the laser components.

The polycrystal measures 16 inches long by 12¾ inches thick, and weighs about 55 pounds.

Such a crystal was undreamed of in 1970, when LASL's CO_2 development program began. LASL researchers have concentrated on developing a carbon dioxide system because there are many advantages to the gas lasing medium. Its laser light is invisible, in the infrared segment of the spectrum, which posed a problem only recently solved (see related story on Page 1), and the problem of alignment still exists, but it is a laser with demonstrated high efficiency, a capacity for high repetition, and it can be scaled up to the large systems believed to be necessary for a fusion reactor.

By 1972, L-Division scientists had designed a four-stage, single-beam, CO_2 laser system using a technique



Two-level view of busy work crew. Joe Ladish, L-1, (center) looks on as Mary Martinez and Tom Herrera, both Missouri Research Laboratory employees temporarily working at L-Division, check the oil level in E-beam pulser bushing above amplifier. Group on right discusses mirror positioning device. They are (left to right), Carl Elsner, E-2, and Ed Jolly, Ben Maestas, and Gene Zimmmerman, all of L-1.

that employed an electric discharge to pump efficiently the carbon dioxide gas. Within the gas, electrons generated by the discharge excited the CO_2 molecules (mixed with both helium and nitrogen to enhance the process), which then emitted photons of monochromatic (radiation of a single wavelength) light.

Through a complex optical switching device, a short burst of laser light, measuring about 300 mm (1 foot) in length and lasting 1 nanosecond (a billionth of a second) was produced. This pulse had then to be directed through a series of 4 successively larger amplifiers in which the pulse gained energy, from the initial 1/1000th of a joule to 200 joules.

The system worked. It was a prototype for a two-beam system which was built in 1973-1974 and was recently used to generate fusion neutrons in pellets for the first time. In turn, this two-beam system became a prototype for an eight-beam system now under construction. The eight-beam system will determine much of the design of the proposed High Energy Gas Laser Facility (HEGLF). HEGLF is a laser target facility designed to symmetrically irradiate fuel pellets with a total of 100 kilojoules of energy from 72 beams.

Such sequenced development is the key to the success of the LASL laser development program.

Design modifications in the eight-beam system were initiated by experience gained with the two-beam system. Similarly, the two-beam system includes many innovative features developed from the experience gained with the single-beam system.

A case in point is the use of a single, cold-cathode electron gun which is used in 2 separate amplifying regions of the two-beam system, and a "triple-optical-pass" amplifier. The single beam system had 4 bulky amplifiers, each with its own power supply and hot-cathode electron gun. The two-beam system passes a pulse through the triple-optical-pass amplifier 3 times, rather than directing its pulses through 2 strings of 5 amplifiers, necessary if the initial design concept had been followed.

The triple-pass amplifier is a single tank of CO_2 into which as much as 4 kilojoules of electrical energy is deposited. In the eight-beam system, 8 such tanks will be placed around the periphery of the target pellet chamber. They will be used to increase the energy of 8 laser beams before they are focused upon a target.

It is at the triple-pass amplifier that the giant polycrystal of germanium will be used to correct the problem of spontaneous (self) lasing, the unwanted and harmful buildup of radiation in the system.

Germanium that is "doped" (impregnated) with gallium is the

This picture was taken from the inside of an amplifier tank to frame Tom Carrol, L-1, and Marguerite Maes, an employee of the Albuquerque-based Missouri Research Laboratory. She is working for LASL on loan to L-1 through E-2.

best medium found to date to correct the problem of self lasing. This problem arises in any laser system, and it must be contended with every step of the way, from the generation of a pulse to irradiation of a fusion fuel pellet.

The crystal acts as a saturable absorber. A tiny piece of gallium-doped germanium crystal is being used in the front end of both the two-beam and eight-beam systems in an effort to prevent spontaneous lasing there.

The material has the ability to selectively absorb the low energy pulses that can cause spontaneous lasing while transmitting the high energy, desirable pulse.

Typically, in technological development, you correct one problem only to be faced by another.

To be useful in a fusion reactor, a laser system must be developed that can deliver huge amounts of energy in an incredibly short span of time to a microscopic fuel pellet. And, it must be capable of doing so repeatedly.

With that goal in mind, researchers operating the single module of the LASL eight-beam system that is near completion, were faced with the task of shortening the 1-nanosecond pulse generated in a single oscillator tube to a one-fourth-of-a-nanosecond pulse.

To do so, they designed a "fast switch"—an assembly of cadmium-telluride crystals that, like the germanium crystal, is capable of selective performance. An apt analogy might be the standard demonstration of the effectiveness of a polaroid lens for filtering out light. If you cross one lens in front of the other, less light will pass through. If you control the crossing time, you have, in effect, created a "temporal" (time) switch.

Now the beam is desirably short, but it has too little energy. And it is when a beam is amplified that the problem of self lasing is most acute. Hence the use of the small, gallium-doped germanium crystal. It stops the self lasing, but it makes it impossible to use visible light to align the laser.

The lasers with which most people are familiar—helium-neon and argon-ion—are visible light, and it is easy to align them. The invisible CO_2 beam is more difficult to align.

L-Division's solution was to incorporate a "plasma smoothing tube" into the oscillator. This device has several important functions in the system, one of which is to allow the CO_2 laser to operate continuously at low energy outputs to produce a beam which is colinear with the pulsed beam—in effect, a pilot beam for the system. This pilot beam can be detected with instruments, or even aimed at a piece of paper to burn a hole indicating its exact position and thus its true course.

Speed And Energy Are Key Factors

The single module nearing completion in the eight-beam system operates on 4 wavelengths in a single band of the light spectrum at 10 micrometers. Closely spaced wavelengths are a must, if the maximum amount of energy is to be extracted from a laser system. With this in mind, L-Division scientists designed the eight-beam system to ultimately operate on many wavelengths at 9 to 10 micrometers.

Two bands and multiple wavelengths will allow them to extract maximum energy from the system very quickly, just as multiple drains in a bathtub will drain water from the tub faster than a single drain.

By this means, LASL will achieve the speed and energy necessary for laser fusion. Another problem that has had to be resolved is that of self-lasing in the final power amplifier.

Each of the 8 beams in LASL's system will be 35-cm (14 inches) in diameter by the time it reaches the triple-pass amplifiers surrounding the target chamber. An equally large mirror must be used to reflect the beam through the amplifier for energy gain. Self lasing occurs here when the mirror picks up every phantom photon of light reflected from surfaces within the room, "parasitic" photons that will hopefully be absorbed by the giant polycrystal.

Self lasing can occur again, as the beam makes its first pass through the amplifier. To correct this, L-Division researchers designed a vacuum extension tank. (The difference in atmosphere between the tank and the room is sufficient to stabilize the beam, which is then directed back to the large reflector mirror to make a second sweep through the amplifier.)

Each beam must be directed through this sidearm vacuum tank as it emerges from the amplifier. But another problem arises here, for as the beam gains in energy it becomes increasingly difficult to find material for a directing lens that will not be destroyed by radiation. L-Division's solution is a 35-cm window made of sodium chloride—table salt—a window that must be handled with tender loving care, but one that works beautifully for the CO_2 wavelengths.

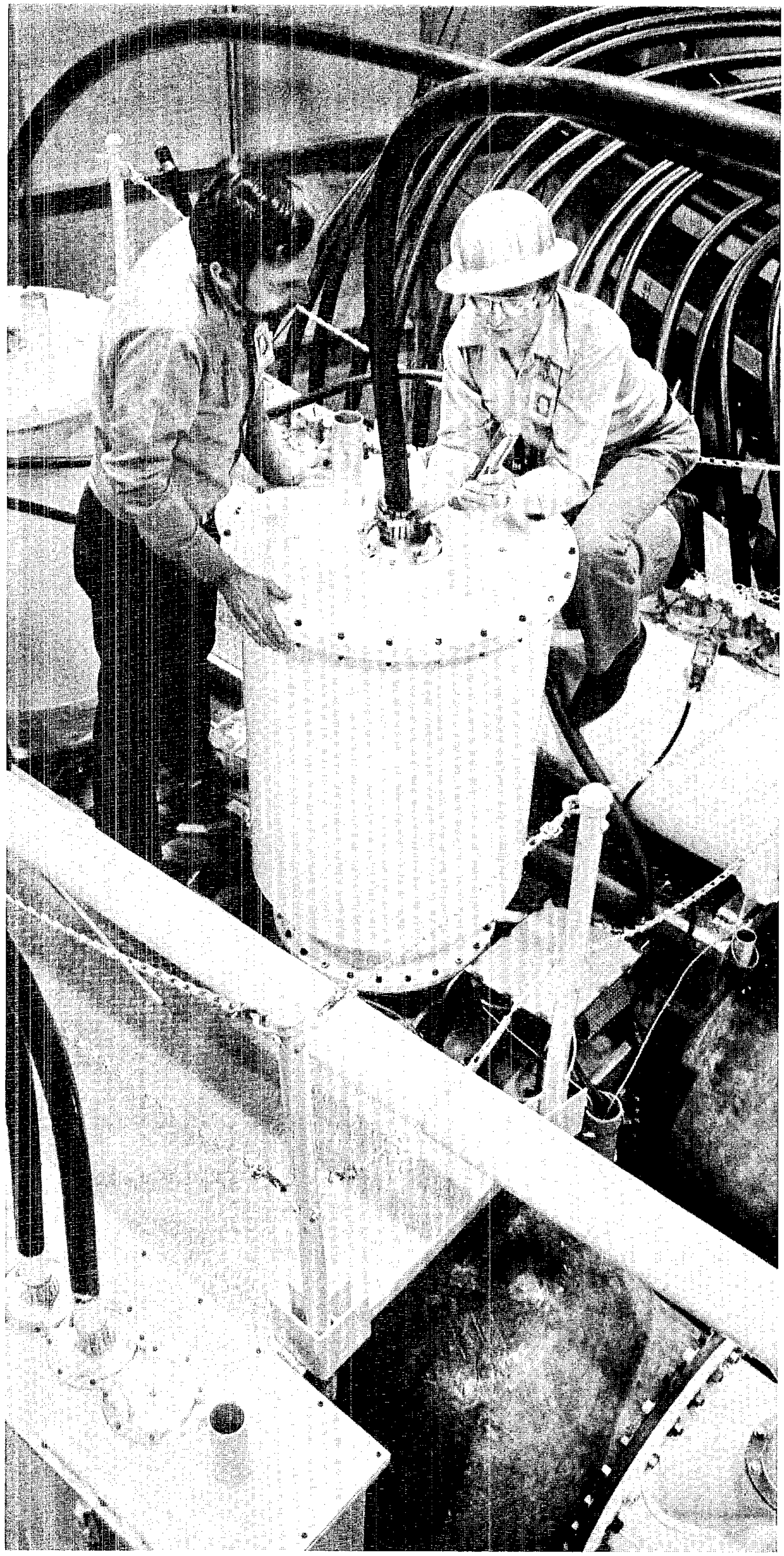
Three passes through the amplifier and the beam, invisible and intensely powerful (the eight-beam system has a design goal of 1.25 kilojoules per beam delivered in one-fourth of a nanosecond) is now focused down to a diameter of 100 micrometers.

Mike Montgomery and Joe Ladish, L-1, check the beam of the probe laser used for alignment in the eight-beam CO_2 system, using time-honored system which involves burning a hole in a piece of paper. Check was made in preparation for a shot.

Each of the 8 beams must be delivered on target simultaneously and they must be accurately aligned for uniform irradiation of the pellet.

L-Division's chief, Roger Perkins, has no doubt they can do just that by 1978.

If the large germanium crystal delivered in March does its job so that the full energy of the eight-beam system is developed and delivered to the targets without prelasing, a major milestone in the program will have been reached.



Ed Jolly and Gene Zimmerman, both L-1, inspect the E-beam pulser bushing on one of the dual-beam modules of L-Division's carbon dioxide laser system.

Sidney Singer, L-1 group leader (left) smiles with satisfaction after successful pellet implosion using two-beam systems. Here he joins personnel from L-1, E-2, and E-4, at computer control center for L-Division's eight-beam system. From left are Ed Jolly and Mike Thomason, L-1, Dave Remington, E-4, Joe Ladish, L-1, John Sutton, E-2, Bill Kelly, L-1, and Gilbert Salazar, L-1.

short subjects

James L. Anderson, CMB-3, has been named manager of the Tritium Systems Test Assembly (TSTA) program, and **Robert H. Sherman,** Q-26, has been named alternate program manager. The TSTA program is designed to simulate the handling cycle of the gaseous deuterium and tritium fuel for a Tokamak-type fusion power reactor, and LASL was chosen to design the assembly. The test assembly will incorporate activities such as the preparation of fuel, placement of fuel into a simulated reactor, pumping out of spent fuel, and the repurifying and recycling of fuel.

Retirements: **Paul J. Masanz,** WX-3, staff member; **Richard T. Schmitt,** SD-5, laboratory machinist; **Wallace H. Borkenhagen,** CTR-4, staff member; **James J. Dvorak,** SP-3, warehouse supervisor; **Ruth V. Romero,** SP-12 liaison officer, small business and minority programs, **John A. Zastrow,** MP-11, mechanical technician.

PATENTS

Larned B. Asprey, CNC-3, was granted U.S. Patent 3,989,808 on Nov. 2, 1976, for a method of preparing pure fluorine gas. The method uses alkali metal-nickel fluoride to absorb tank fluorine by forming nickel complex salts and leaving the gaseous impurities, which are pumped away. The complex nickel fluoride is then heated to evolve back pure gaseous fluorine.

Anthony J. Campillo, Brian E. Newman, Stanley L. Shapiro, and **James Terrell,** all L-2, were granted U.S. Patent 3,935,545 on Jan. 27, 1976, for a method and apparatus which reduces diffraction-induced damage in high-power laser amplifier systems. The invention abstract states that damage may be minimized by tailoring the input optical beam profile by passing the beam through an aperture having a uniform high optical transmission within a particular radius and a transmission that drops gradually to a low value at greater radii. Apertures having the desired transmission characteristics may readily be manufactured by exposing high resolution photographic films and plates to a diffuse, disk-shaped light source and mask arrangement.

C. John Umbarger, H-1, and **Leo R. Cowder,** R-1, were granted U.S. Patent 3,988,615 on Oct. 26, 1976 for a method of radioactivity monitoring. The invention relates in particular to monitoring for uranium and thorium content in liquid effluents placed in a sample counting chamber. One object of the invention is to provide economical on site monitoring capability, and another object is to provide detectability as low as 10 nanocuries per gram using a portable detector for transuranic solid bulk wastes.

Anton Mayer, CMB-6, was granted U.S. Patent 3,994,796 on Nov. 30, 1976, for an electrolytic plating apparatus for discrete microsized particles. According to the abstract, the method and apparatus will produce very uniform coatings of a desired material on the microsized particles. Agglomeration or bridging of the particles during the deposition process is prevented by imparting a sufficiently random motion to the particles that they are not in contact with a powered cathode for a time sufficient for such to occur.

Thurman G. Frank, L-5, **Edward S. Keddy,** R-3, and **George M. Grover,** former LASL employee now retired, were granted U.S. Patent 3,994,778 on Nov. 30, 1976, for an invention which relates to a barrier for inhibiting hydrogen diffusion from a nuclear fuel element containing a metal hydride moderator and operating at temperatures at which a substantial hydrogen dissociation pressure exists. More specifically, it relates to a hydrogen barrier consisting of a liquid metal such as liquid lead.

Michael J. Antal, Jr., former employee of LASL and now a professor at Princeton University, was granted U.S. Patent 3,993,458 on Nov. 23, 1976 for a method for producing synthetic fuels from solid waste. The system of the invention uses solar energy to provide heat for the pyrolysis of solid wastes and the gasification of the remaining char.

Stephen D. Rockwood, AP-2, **Robert E. Stapleton,** L-DO, and **Thomas F. Stratton,** L-10, were granted U.S. Patent 3,973,213 on Aug. 3, 1976, for an invention which relates to electrically pumped high-energy gas laser amplifiers in which gas breakdown of the lasing medium is substantially obviated.

LASL Exhibit

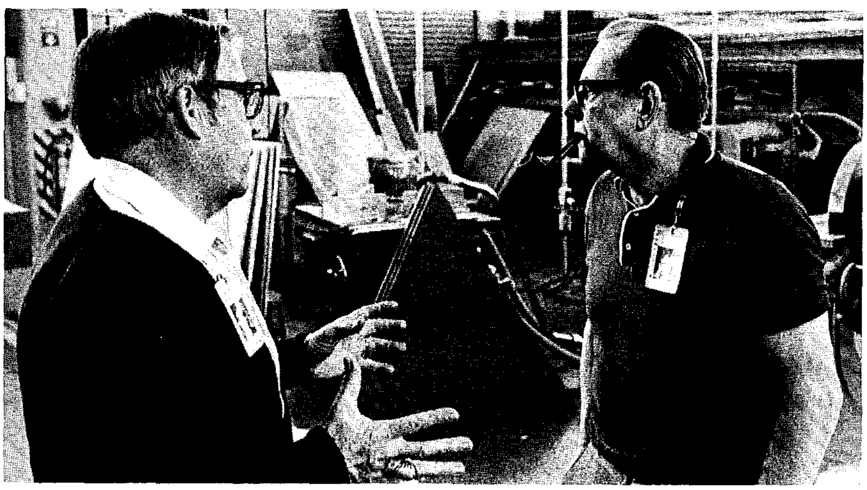
ISD-2, at the request of Ed Hammel, assistant director for energy, developed an exhibit on LASL's involvement in energy research and development for display at the Museum of Albuquerque.

The exhibit, viewed from January 29 to March 14, was in conjunction with a symposium, "Energy and Society: The Next Thirty Years," held at the convention center in Albuquerque.

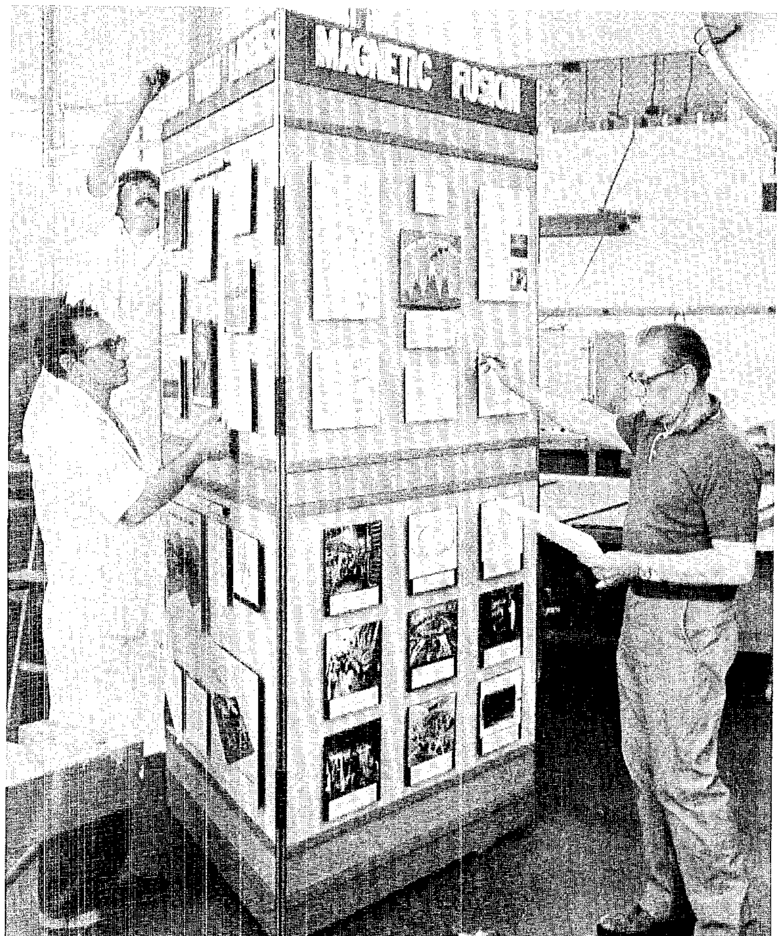
Areas of LASL research exhibited were laser isotope separation, geothermal energy, solar mobile modular home concepts, superconducting power lines and storage, use of pi mesons in cancer therapy, fusion by electromagnetic confinement, laser fusion, and nuclear safeguards and reactor safety.

Bob Porton, ISD-2 group leader, said the LASL exhibit was designed to be understandable to the layman, and he praised the efforts of the project's chief coordinator, Bob Brashear, ISD-2, and people in ISD-3, ISD-7, and the Laboratory's Shop Department in getting the exhibit put together.

The exhibit was popular with thousands of visitors to the Albuquerque museum, according to Porton, and it will be used on a rotating basis in the Bradbury Science Museum at LASL.

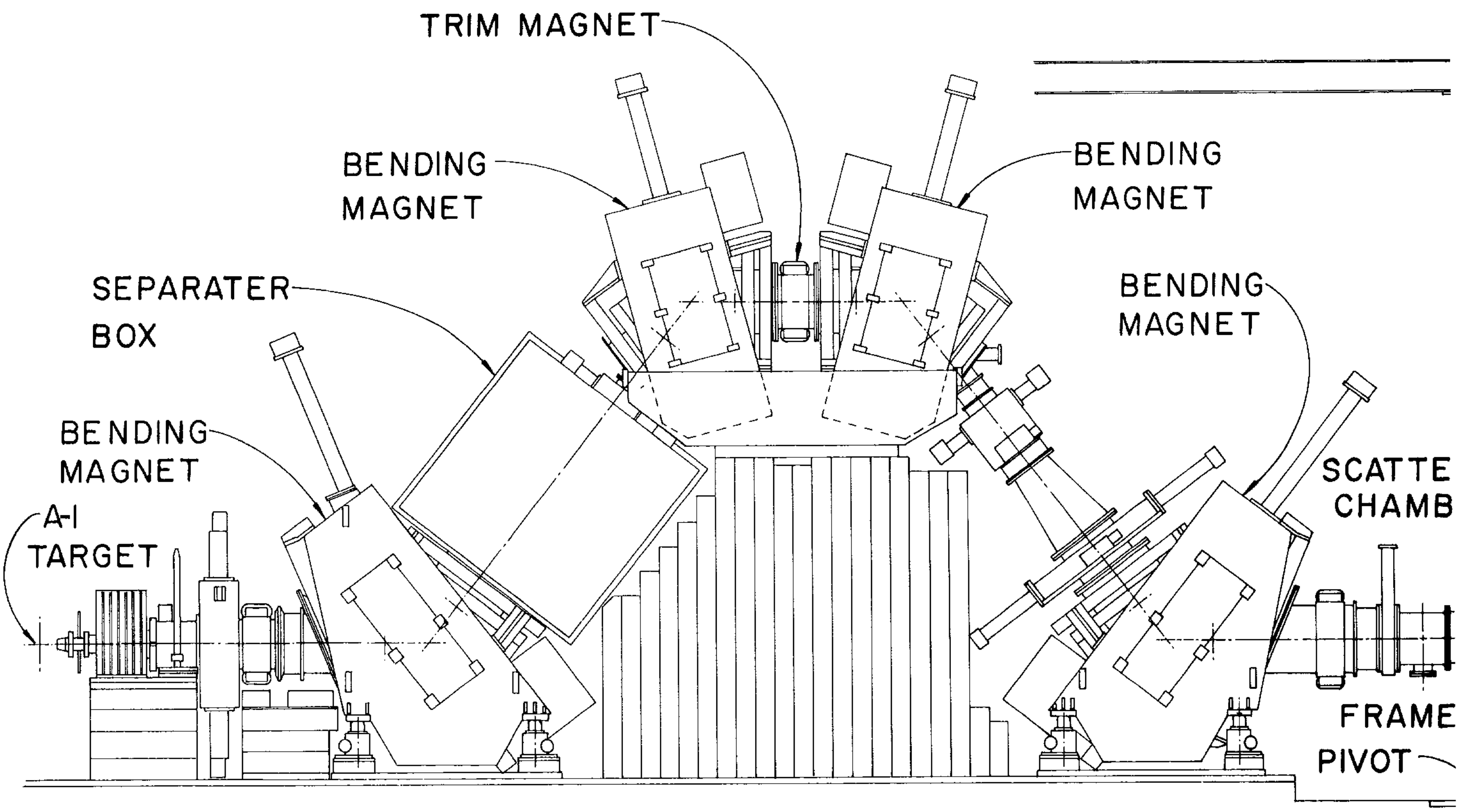


In the top photo, a visitor studies information panels in LASL's exhibit as Bob Porton, ISD-2 group leader, kneeling left, and John McHale, ISD-2, look at a cutaway model of a solar panel for a solar mobile modular home. At left, Bob Brashear, ISD-2, and John Mench, model shop supervisor in the Shop Department, discuss plans and layout for the exhibit.



Bob Porton strolls through the assembled LASL exhibit in place at the Museum of Albuquerque, top photo, and at right, Bruce Martinez, reaching in the background, Daniel Romero, and John Mench, all of the model shop in the Shop Department, assemble parts of a panel to be used in the exhibit.

Another Supermagnet At LAMPF



Another "supermagnet" this spring will become a permanent fixture at the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF).

Termed EPICS (Energetic Pion Channel and Spectrometers), the spectrometers will analyze energy of scattered pions in 100-MeV to 500-MeV experiments.

A pion spectrometer of this type has not been built before, according to Arch Thiessen, MP-10 Group Leader, and Nobuyuki Tanaka, MP-10, the 2 principal physicists involved in design and construction of EPICS. The spectrometers differ from others primarily because of the energy levels of the experiments to study characteristics of the pions in the nucleus.

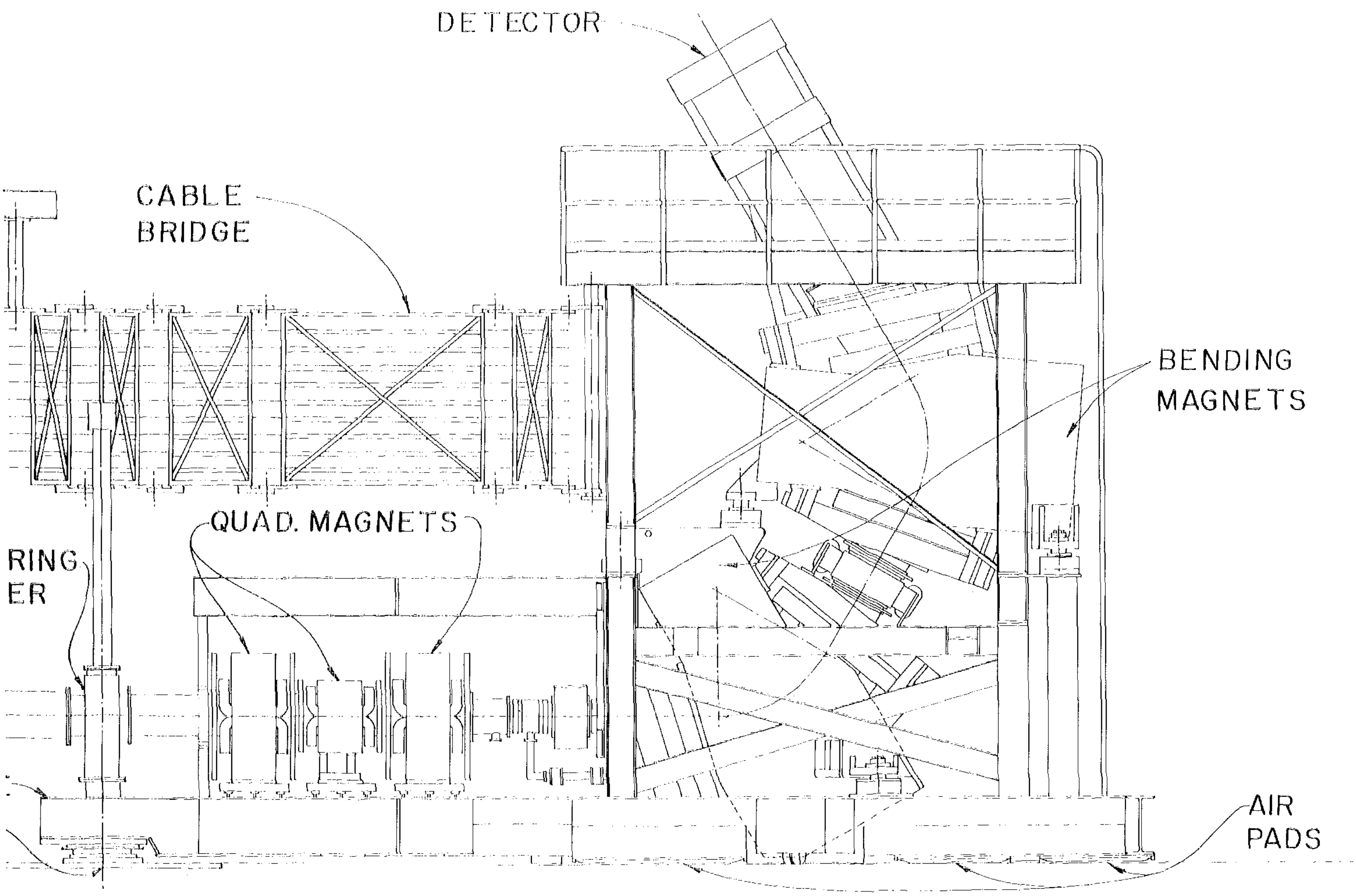
Essentially, the spectrometers will use a secondary beam diverted from the main beam of protons as they strike a target at up to 800 MeV. Pi + mesons and Pi − mesons, produced as the proton beam strikes its target, are the primary probing particles to be channeled into the spectrometer and ultimately to the detectors which record characteristics of the scattering and analyze energies.

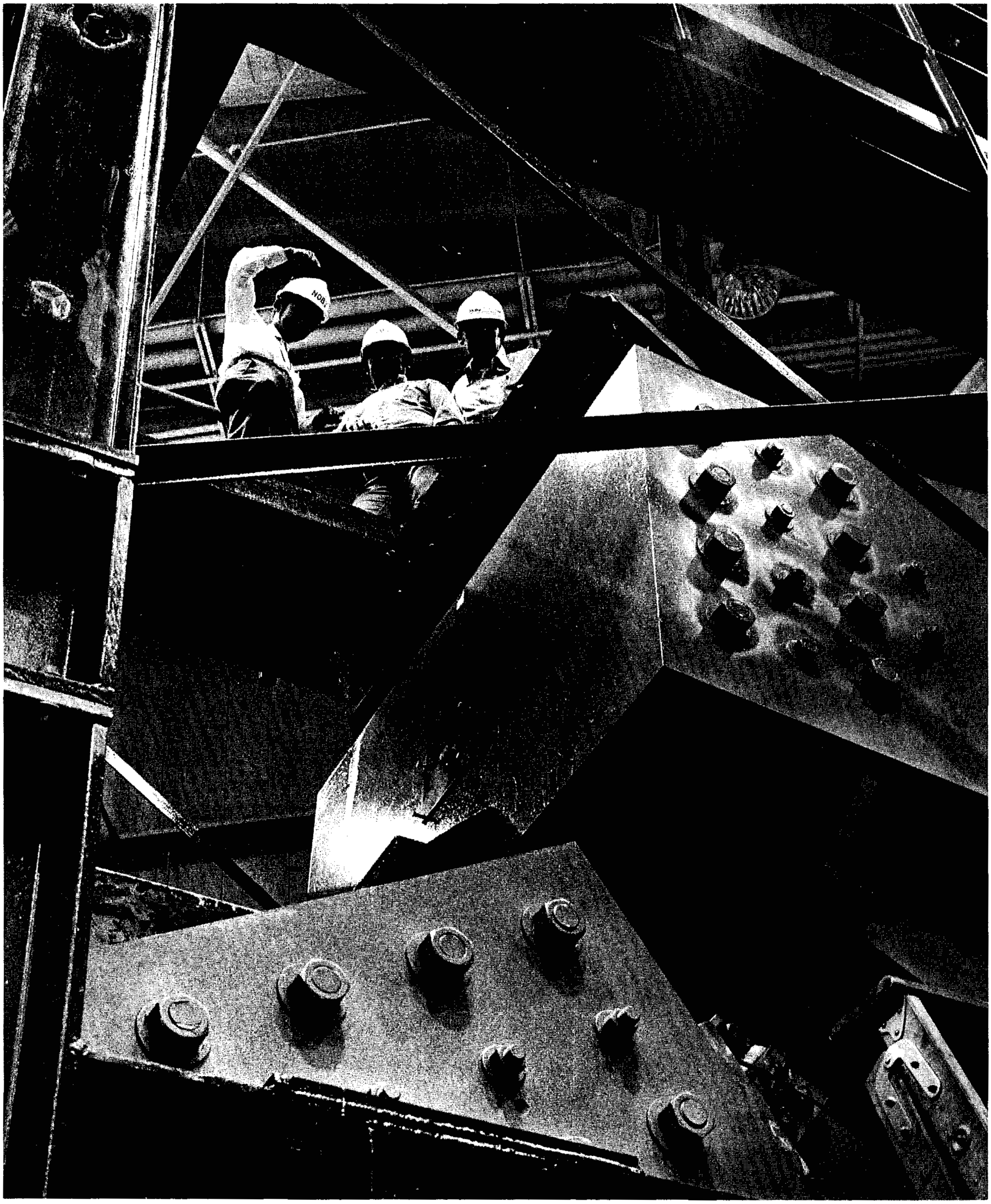
EPICS is a unique system combining the techniques of low-energy nuclear physics (using precision magnet systems) with high-energy detectors.

The main goal of EPICS research is to study the interaction of pions and nuclei, and especially to note the differences between pions and more conventional nuclear probes such as protons and deuterons.

The huge EPICS assembly, when completed, will consist of 2 dipole magnets weighing 90 tons each, several smaller magnets, stands, cable trays and peripheral support equipment; will weigh about 300 tons; and will be installed at a 90-degree angle to the main beam line in Experiment Area A.

The large dipole magnets will





Nobuyuki Tanaka, left, and Joe Kosty, center, both MP-10, and Jim West, WX-4, peer through the structure supporting the high-resolution pion beam spectrometers of the soon-to-be-completed energetic pion channel and spectrometers (EPICS) assembly at LAMPF.

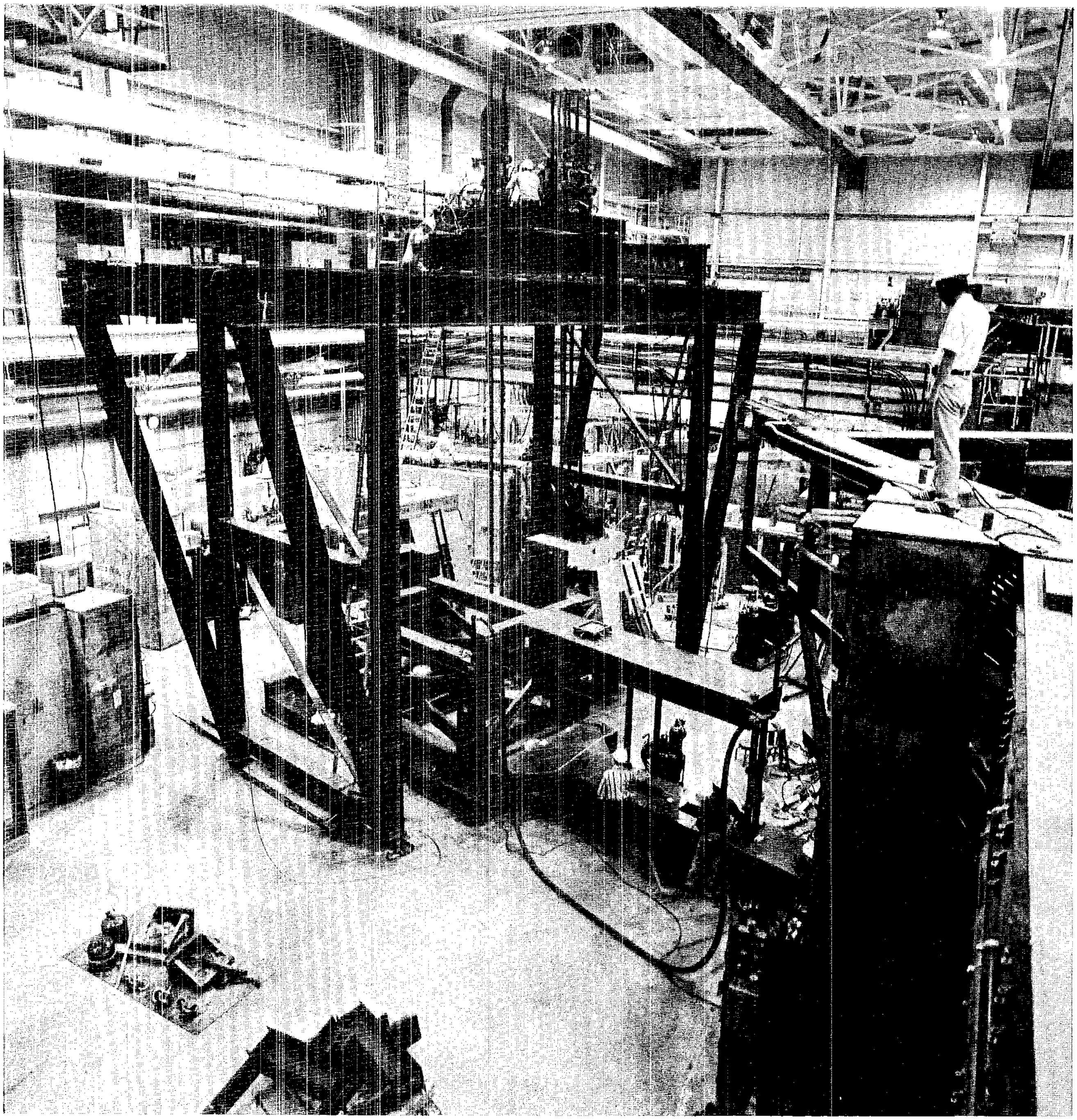
have an electrical capacity of 2,000 amperes, and will be cooled with about 100 gallons of water per minute.

Because of the structure's overall weight, a section of the floor in Area A had to be dug up and re-poured with 2 feet of heavily reinforced concrete, instead of the average 8 inches of concrete. The structure rides on air pads, and can be easily moved by the pushing of several persons. However, moving will be done by air-motor-driven wheels.

The 2 big magnets were constructed in 10-ton segments, carried to the experiment area, and assembled. Because of the magnets' weight when assembled, crane load capacity would not permit their being transported to Area A ready to mount.

Tanaka, Thiessen, and Wade Dunwoody, R-4, mechanical engineer coordinating construction of the channel and spectrometers, are

Tanaka inspects the construction of EPICS and the superstructure built to contain it.



expecting to have the EPICS completed and ready for preliminary tests in April or May. It will be several months later, however, before the first experiment can be conducted using the entire system.

Project coordinators say some experiments have already been done using the channel sections of the EPICS, and have proved the sections to be accurate and ready for further use.

Tanaka, who also worked on assembly of the high-resolution spectrometers (HRS) at LAMPF, has been working on the EPICS project for less than a year. "I gained much experience with construction of the HRS, and I have been able to use that experience in the EPICS project. It has shortened the amount of time necessary to do the work."

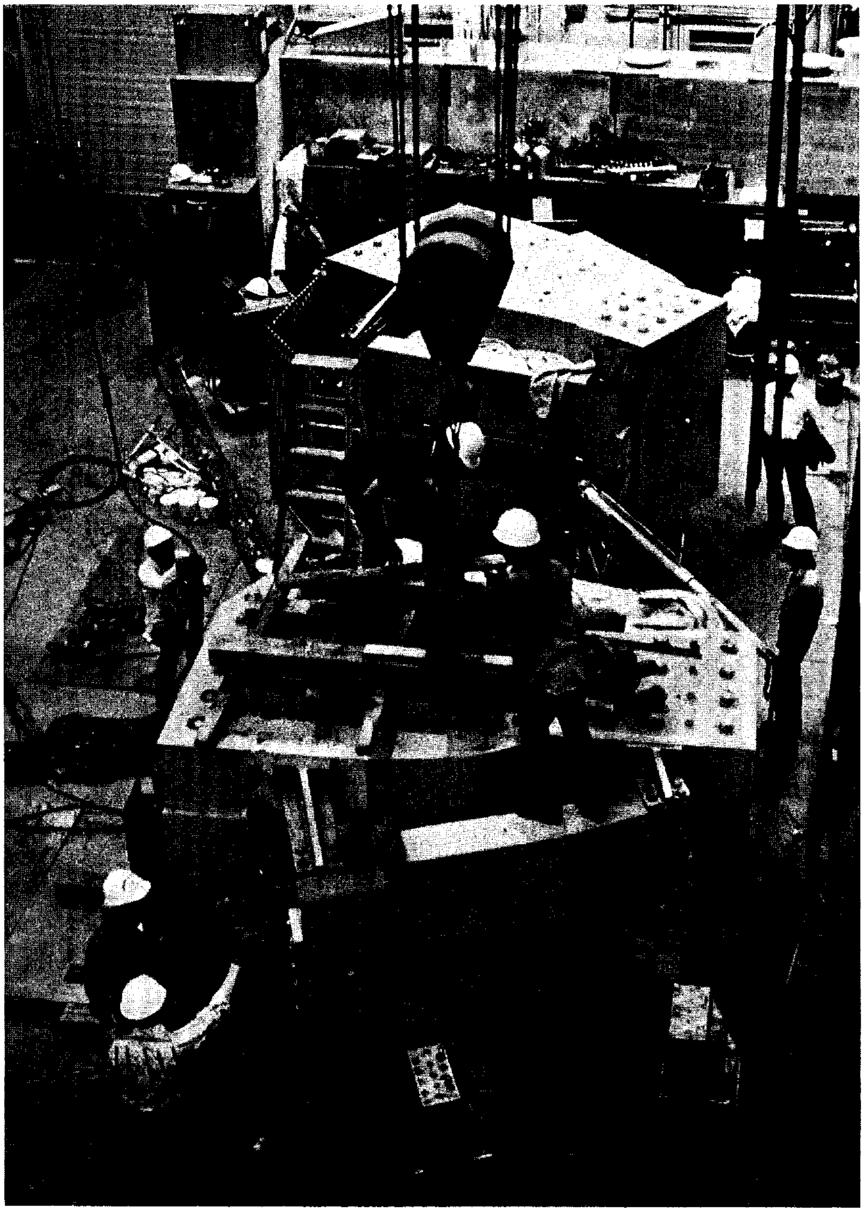
He added that the energy measurements and the nature of the information needed from experiments with EPICS, required less hand work in finishing the magnets. Dimensions and specifications of the HRS magnets had to be much more exact than the magnets for EPICS. "This resulted in additional time savings," he said.

More than a dozen technicians have been actively involved in readying EPICS for its near-future beam tests and experiments.

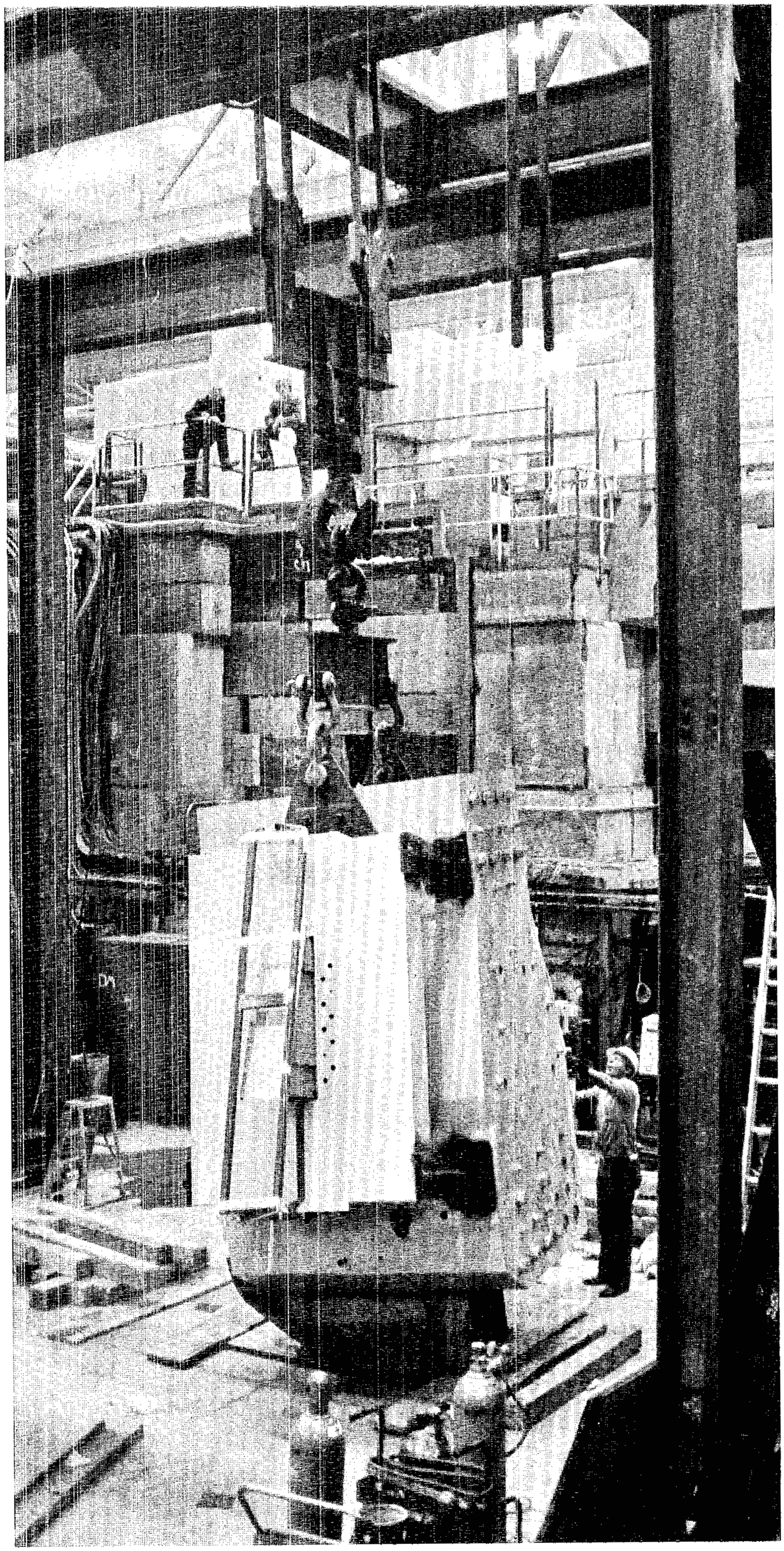
"Many, many people have been connected with the project: engineers, technicians, scientists, people from various divisions and groups of the Laboratory," said Tanaka, "but the core of a dozen or so people has been on the project since its beginning."

And Tanaka, now nearing completion of his second "supermagnet" venture at LAMPF, readily admits that the work and cooperation of many people is necessary to produce EPICS, a new opportunity for new studies in medium-energy physics at LASL.

The two 90-ton dipole magnets and high resolution pion beam spectrometers are prepared for lifting into place in the EPICS assembly.



One of the magnets is lifted cautiously.



Forest Service Is Seeking Volunteers

The Espanola Ranger District of the Santa Fe National Forest needs volunteers to help in the conservation work of the Forest Service.

Persons with skills in environmental interpretation and education, photography, visitor information services, exhibit design and display, journalism, conducting nature walks, and preparation of slide-tape programs are especially needed.

The Forest Service can use persons of all ages from retired persons to teenagers but volunteers under the age of 18 must have written consent from his or her parent or guardian.

A volunteer may work full time, a few hours each week, or contribute a "one time" service. Applications can be obtained at the Forest Service office in the lobby of the ERDA building in Los Alamos. Volunteers will not receive any wage or other compensation for their donated services.

10 years ago in los alamos

Culled from the March, 1967 files of
The Atom and The Los Alamos Monitor by Robert Y. Porton

BANG!

"Sleeping Beauty" awoke Tuesday after more than 20 years at rest at Trinity Site in Southern New Mexico. Unlike the fairytale princess who slept for 100 years and was awakened by a gentle kiss from a prince, this Sleeping Beauty was startled from her slumber by a "Bang." Sleeping Beauty was a code name given to an experiment of LASL after it fizzled on test day—Sept. 8, 1946. The physics experiment involved a small quantity of high explosive which failed to detonate at the time. Today's test was termed successful by Laboratory scientists with the original HE being detonated—removing all danger of an uncontrolled explosion.

SPEAKERS:

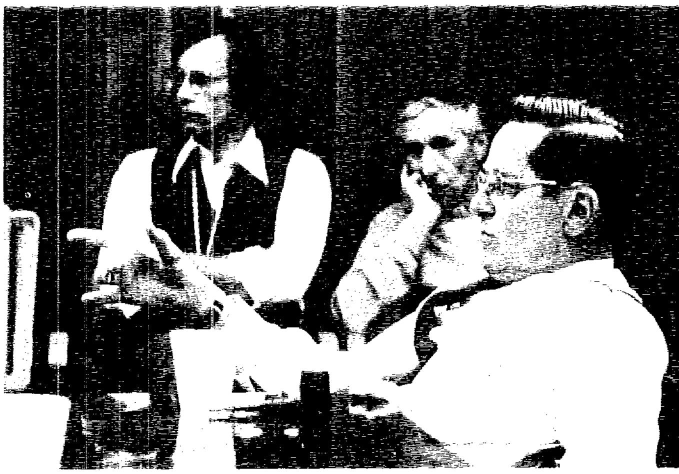
Harold Agnew, W-Division Leader, was a speaker at the Air Force Association's 21st anniversary national convention in San Francisco last week. Agnew took part in a symposium entitled "The Technological Threat." Another featured speaker at the meeting was Secretary of the Air Force Harold Brown.

LASL PROJECTS:

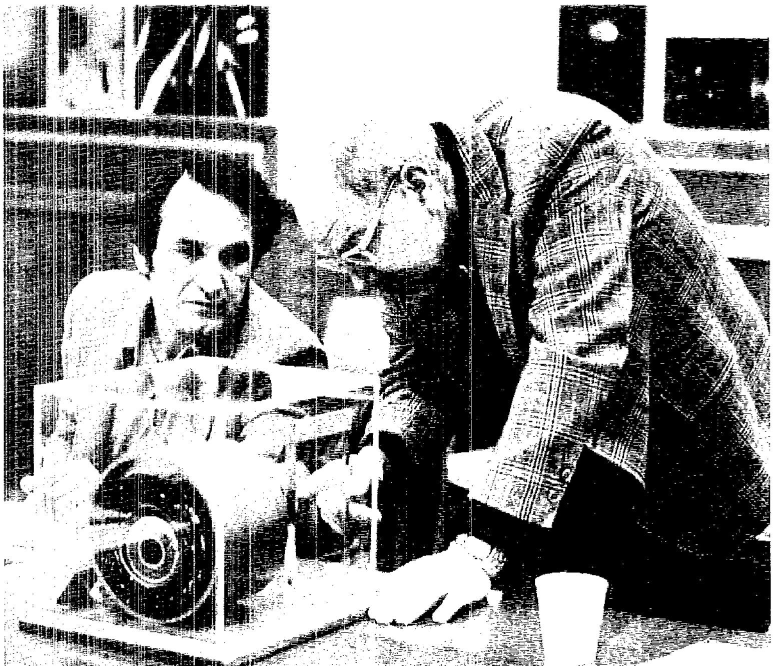
A giant stride down a long road was taken by the Los Alamos Scientific Laboratory this month, but it had help in high places. President Johnson has submitted an amended budget message to Congress in which he asked that $50.3 million be appropriated during the fiscal year beginning next July to construct a "meson factory," and $8.5 million for a Scyllac machine, both at Los Alamos. First conceived in 1962, the meson facility will be a variable energy 800 million electron volt proton accelerator which will provide a beam current of one milliamp, an external beam current more than a thousand times higher than that of any existing accelerator of comparable out-put energy. Scyllac is planned as a new Project Sherwood containment experiment at LASL.

Among Our Guests

John N. Ott, former director of the Center for Light Research in Buffalo, N.Y., conducts a question-and-answer session for LASL employees in the OHL conference room during his February visit to the Laboratory. He spoke on "The Effects of Fluorescent Light and TV Radiations on Human Behavior" at a colloquium.



General Robert J. Dixon, commander of the U.S. Air Force's Tactical Air Command, engages in classified discussions with LASL staff members in the Green Room of the Administration Building. Dixon was in Los Alamos in January to speak on "Tactical Air Command" during a special meeting of staff members.



Ed Hammel, right, LASL's assistant director for energy, discusses superconducting transmission lines with U.S. Rep. Tom Harkin of Iowa. Harkin, a member of the House Science and Technology Committee and 3 subcommittees on energy, science research, and technology, was in Los Alamos recently for a briefing on energy and research developments.

Icicles always hang vertically from a roof or fence or whatever. Or, at least most of them do, this one excepted. Bill Jack Rodgers took this picture of a horizontal icicle suspended from the roof of the Occupational Health Laboratory. Not ignoring gravity entirely, the ice mass separated from the accumulation of snow and ice above it, but appears to have been formed horizontally.